COMPARATIVE RISK ANALYSIS AT ORDNANCE CONTAMINATED SITES

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Abstract

QuantiTech has developed a methodology that correlates public exposure to unexploded ordnance (UXO) to the probability of injury or death due to UXO resulting from that exposure. The basis for this methodology is historical UXO accident data coupled with OE*Cert* based exposure calculations collected from the 38 ordnance and explosives (OE) sites where QuantiTech has performed comparative risk analysis. The collected accident data was plotted as a function of time and analysis was performed to determine the appropriate statistical distribution to describe the data set. Equations were derived from the statistical distribution fit to the accident data that calculate the expected number of UXO related accidents that will result in injury or death during the next year for a specific site. The Comparative Risk Analysis Methodology provides accident projection by combining the expected land uses and the calculated OE*Cert* exposures at a specific site with the statistical distribution fit to the historical UXO accident data. The methodology also provides a mechanism for comparing the number of UXO related accidents expected at the site to the number of accidents resulting in injury or death to members of the community surrounding the site from common everyday activities or risk sources. Application of the Comparative Risk Analysis Methodology provides a method for communicating public risk effectively and concisely to all stakeholders at the OE site.

Background

Risk to recreational or occupational users or landowners of a site is typically communicated in terms of risk of exposure to unexploded ordnance (UXO). An exposure means that a person comes in close proximity to a surface or subsurface UXO while on the site, whether or not its presence is known to the individual. Occasionally, this definition has been erroneously understood to mean risk of accident. Experience from the study of historical UXO-related accidents as they relate to exposures has shown that chance of death or injury per exposure is exceedingly small. By analyzing the relationship between accidents and exposures, QuantiTech has been able to derive a measure of the site risk of an ordnance-related accident.

Methodology

The Archive Search Report (ASR) for each ordnance site provides historic (civilian) accident data. The study of 38 such reports completed to date revealed 41 ordnance-related accidents resulting in death or injury which could be validated by date of occurrence. These 41 accidents were caused by 12 ordnance incidents, spanning a period from 1936 through 1993 (58 years). They resulted in 16 fatalities and 25 injuries.

A histogram or bar chart was developed for the accident data and reproduced in Figure 1. Seven-year periods were chosen in order to analyze the data trend and fit an appropriate statistical distribution. It is obvious from the histogram that the majority of deaths and injuries occurred in the years immediately following World War II, when many of the sites were abandoned by the military. This is also evident if only the 12 incidents are similarly graphed, since 8 of the 12 occurred prior to 1956. Perhaps the reasons for this decline in accidents over time include better public awareness, as well as historical surface clean-up efforts at the sites (particularly following accidents), which reduced risk.

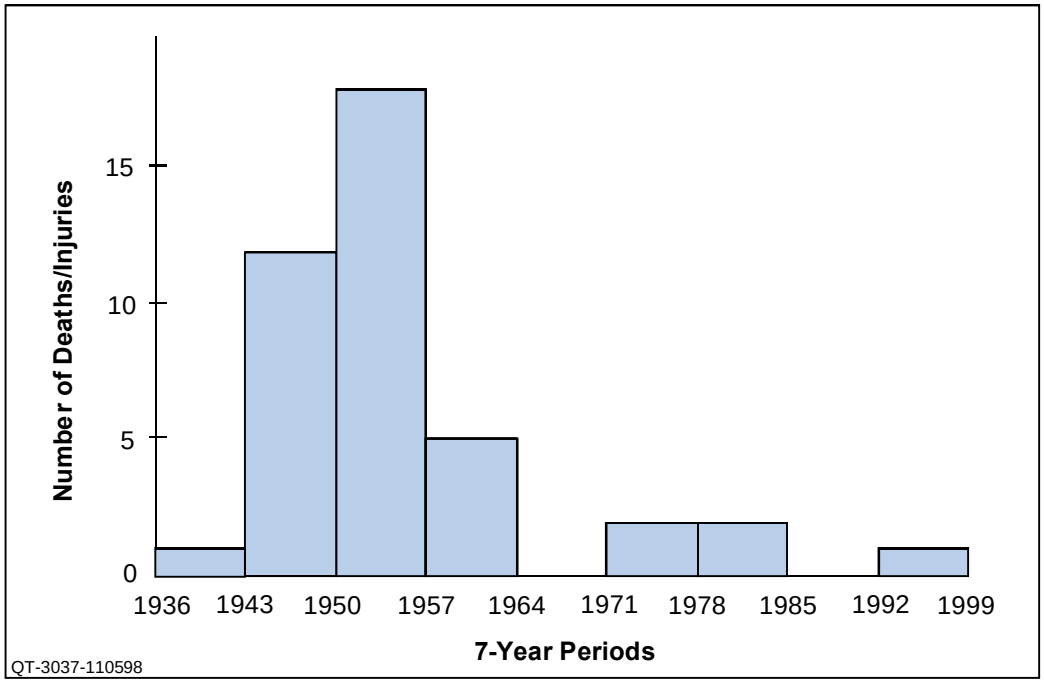

Figure 1. Number of Deaths/Injuries Among 38 Ordnance Sites from 1936 to Present

The data used to generate the histogram shown in Figure 1 was fit to a gamma statistical distribution. A chi-square goodness-of-fit test was performed to insure that the gamma distribution was the appropriate distribution to describe the data set.

The number of UXO injuries or deaths that can be expected at a specific site during a given year can be estimated by first integrating the probability density function of the gamma distribution and multiplying the result by the aggregated number of historical accidents. The result of this mathematical operation is then combined with the number of Ordnance and Explosives

Cost-Effectiveness Risk Tool (OE*Cert*) exposures estimated for the site. The resulting value is the expected number of UXO related injuries or deaths that can be expected at the ordnance-contaminated site under analysis during the upcoming year. This number of expected UXO related injuries or deaths is placed in context with the risk of injury or death to members of the surrounding community from common sources (i.e., automobile accidents, in-home accidents, etc.) to facilitate the communication of ordnance risk with members of the public and regulatory agencies.

Conclusion

Comparative risk provides an effective method of communicating risk to the public from UXO. The model presented is expected to evolve as more ordnance sites are studied and more accident data becomes known.

References

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About The Author

Dr. John N. Lovett, Jr., is a Senior Staff Engineer at QuantiTech, Inc., in Huntsville, Alabama. He received the Ph.D. degree in Industrial Engineering from the University of Arkansas in 1977. Between 1976 and 1984 he was Associate Professor in the College of Engineering at the University of Tennessee at Chattanooga. From 1984 to 1991 he served in the same capacity at the University of Alabama in Huntsville. From 1978 to the present he has provided engineering consultation services to 28 manufacturing, service, and government organizations. Dr. Lovett has taught and/or consulted in areas including statistics, quality assurance and management, operations research, work design, ergonomics, decision theory, and manufacturing processes. He and his wife Janie live in Tennessee where they own and operate an 1873 water-powered mill, museum, and bed-and-breakfast.

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